



## NASA SBIR Select 2012 Phase I Solicitation

### E1.02 Nano/Micro Satellite Launch Vehicle Technology

Lead Center: KSC

Participating Center(s): ARC

The space transportation industry is in need of low-cost, reliable, on-demand, routine space access. Both government and private entities are pursuing various small launch systems and architectures aimed at addressing this market need. Significant technical and cost risk exist in new system development and operations, reducing incentives for private capital investment in this still-nascent industry. Public and private sector goals are aligned in reducing these risks and enabling the development of small launch systems capable of reliably delivering payloads to low Earth orbit. The Nano/Micro Satellite Launch Vehicle (NMSLV) will provide the nation with a new, small payload access to space capability. The primary objective is to develop a capability to place nano and micro satellites weighing up to approximately 20 kilograms into a reference orbit defined as circular, 400 to 450 kilometer altitude, from various inclinations ranging from 0 to 98 °. This subtopic seeks commercial solutions in the areas of nano and micro spacecraft launch vehicle technologies, with particular focus on higher risk entrepreneurial projects for dedicated nano and micro spacecraft launch vehicles and components. Proposals should include, but not be limited to, the following areas:

- Orbital booster designs of system/architectures capable of reducing the mission costs associated with the launching of small payloads to LEO. The designs should focus on the following:
  - Develop and implement technologies for small, lightweight, robust avionics packages for launch vehicle control, systems monitoring, autonomous flight termination, separation systems and TDRS transmitter to support the launch test.
  - Requirements (acceptable to range safety organizations) for Autonomous Flight Termination System(s) for Nano/Micro Launchers.
  - Develop and test the propulsion system for the NMLV by production reducing cost.
  - Development of a ground operations concept to show how the launch vehicle will be integrated, processed and launched.
- Performance predictions, cost objectives, and development and demonstration plans for the NMSLV.
- All proposed sub-orbital booster technologies should be traceable to an orbit-capable Small Launch Vehicle (SLV), whereby specific technologies are identified for Phase II development and test.

The NMSLV would be a smaller vehicle than the Pegasus launch vehicle, which is considered an SLV. For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path towards Phase II hardware/software demonstration with delivery of a demonstration unit or software package for NASA testing at the completion of the Phase II contract. *Phase I Deliverables* - Provide concept designs to include simulations and measurements, proving the proposed approach to develop a given product. Also required for all technologies are performance predictions, cost objectives, and development and demonstration plans for the NMSLV. Formulate and deliver a verification matrix of measurements to be performed in Phase II, along with specific quantitative pass-fail ranges for each quantity listed. The report shall also provide options for commercialization opportunities after Phase II.

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- The concept designs should focus on the following:
    - Nano/Micro Launch vehicle avionics systems for launch vehicle control.
    - Requirements (acceptable to range safety organizations) for Autonomous Flight Termination System(s) for Nano/Micro Launchers.
    - Nano/Micro Launch vehicle TDRS Transmitters System(s).
    - Ground Processing concepts to include range locations.

The technology concept at the end of Phase I should be at a TRL of 2 to 4. *Phase II Deliverables* - Working engineering model of proposed Phase I components or technologies, along with full report on development and measurements, including populated verification matrix from Phase I. Vehicle hardware shall emphasize launch cost reduction technologies, and possess sufficient design information to fabricate, integrate, and operate the selected high-risk component(s) for demonstration. Sub-orbital booster design is required as knowledge is gained through the critical component development process.

- Perform a full duration engine firing testing of each type of engine to be used on the Nano/Micro Launch Vehicle (NMSLV). Second stage engines should be tested in a vacuum.
- Conduct a guided sub-orbital booster flight test of the proposed NMLV.
- Perform performance predictions for orbital flight, cost objectives, and development and demonstration plans for the NMSLV orbital flight.
- Ground operation plan and support level for an orbital test flight to include range locations.
- Development of the Nano/Micro Launch vehicle avionics suite to include launch vehicle control, systems monitoring, separation systems and TDRS transmitter.
- Requirements (acceptable to range safety organizations) and design for Autonomous Flight Termination system(s) for Nano/Micro Launchers.
- All proposed sub-orbital booster technologies should be traceable to an orbital capable NMLV, whereby specific technologies are identified for Phase III development and orbital test.

The technology concept at the end of Phase II should be at a TRL of 7.